About the *Draft Rhode Island K-12 Grade Span Expectations in Science*

The document, the *Draft Rhode Island K-12 Grade Span Expectations in Science,* has been developed as a means to identify the science concepts and skills expected of all students. The draft RI science GSEs encompass the content eligible for inclusion on the large-scale assessment of science in grades 4, 8, and 11. They are not intended to represent the full science curriculum at each grade span, but are meant to capture the "major ideas" of science that can be assessed in an on-demand setting. The goal is that the science GSEs focus the curriculum, but do not restrict it.

The draft science GSEs are written for grade spans K-2, 3-4, 5-6, 7-8, and high school. They describe the science knowledge and abilities students should demonstrate at the end of each grade span. Since the large-scale high school science assessment is given near the end of grade 11, the GSEs for high school for all students are aligned with the content for the assessment. GSEs labeled "**Example Extensions"** are more challenging and provide direction for in-depth study of a particular topic in a course, class or individual student project. The draft RI science GSEs are extracted from the assessment targets developed as part of the framework for the common science assessment conducted in New Hampshire, Vermont and Rhode Island.

As you review the *Draft Rhode Island K-12 Grade Span Expectations in Science,* the following information is important to understand, particularly the relationship between the science GSEs and the science assessment targets.

The draft science GSEs are organized into three **domains; Life Science, Earth and Space Science; and Physical Science.**

1. The three domains are further subdivided into ten **Statements of Enduring Knowledge** (EK) (listed in Table 1) that
    a. are intended to identify the fundamental knowledge/concepts for each domain of science.
    b. cut across grade levels, so that learning is developmental/built upon across grades (although not all aspects of the EK may be addressed at all grade levels)
    c. are of comparable grain size
    d. encompass, as a set, the *essential learning for each domain of science*
    e. imply topics of study (and therefore, lead to focused instruction, as identified in science standards/benchmarks/GSEs)

2. Each **Assessment Target** is linked to one Statement of Enduring Knowledge, as indicated with the target's coding (e.g., LS1 means Life Science and the first EK statement, LS2 means Life Science and the second EK, etc.)

3. Each Assessment Target incorporates one or more **Unifying Themes**, the broader universal principles that integrate the different scientific disciplines. Six Unifying Themes of Science were chosen after an extensive review of the literature and are further described in Table 2.

4. Assessment Targets for high school, middle school, and elementary school were developed by applying the Unifying Themes of science to the Statements of Enduring Knowledge for each of the science domains of Life Science, Earth and Space Science, and Physical Science. **Not every Unifying Theme has an "intersection" with every** Statement of Enduring Knowledge. Development committees used prioritization strategies and field reviews to determine which assessment targets would provide the richest opportunities for large-scale assessment purposes.

TABLE 1 **Statements of Enduring Knowledge (EK) by Domain**	
Life Science	**LS 1** All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, and species).
	LS 2 Matter cycles and energy flows through an ecosystem.
	LS 3 Groups of organisms show evidence of change over time (structures, behaviors, and biochemistry).
	LS 4 Humans are similar to other species in many ways, and yet are unique among Earth's life forms.
Earth & Space Science	**ESS 1** The Earth and earth materials as we know them today have developed over long periods of time, through continual change processes.
	ESS 2 The earth is part of a solar system, made up of distinct parts that have temporal and spatial interrelationships.
	ESS 3 The origin and evolution of galaxies and the universe demonstrate fundamental principles of physical science across vast distances and time
Physical Science	**PS 1** All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another *(independent of size or amount of substance)*
	PS 2 Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.
	PS 3 The motion of an object is affected by forces.

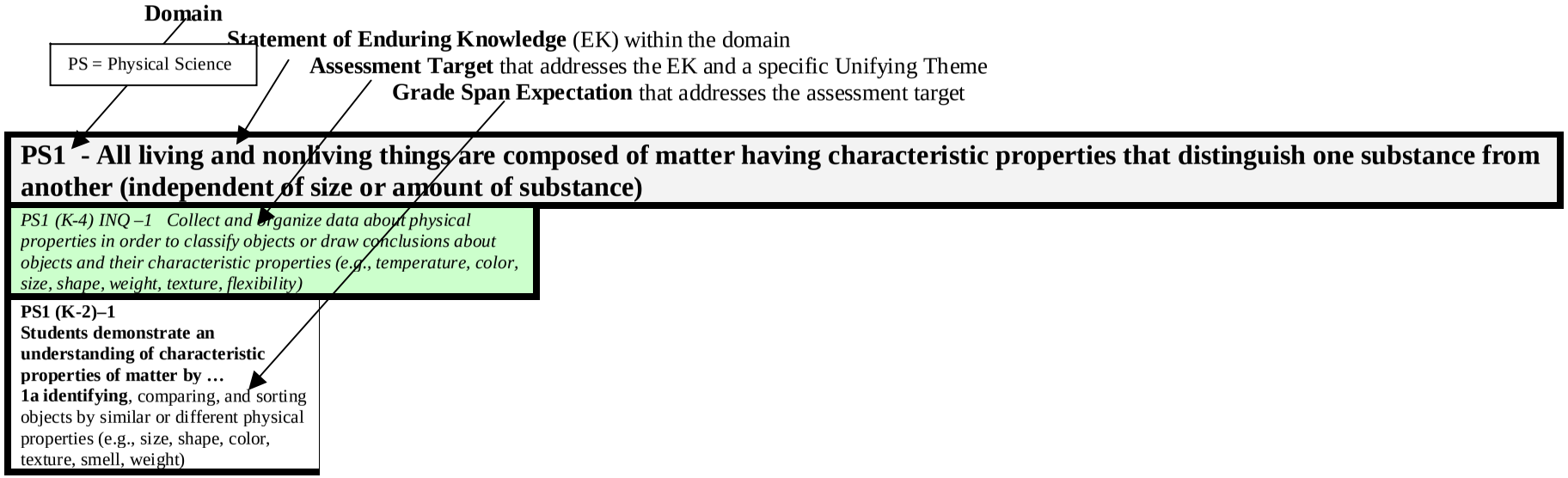
TABLE 2

Unifying Themes of Science

(Subheadings under each Unifying Theme/Big Idea suggest but are not limited to what might be addressed)

Scientific Inquiry	**Nature of Science**	**Systems & Energy**	**Models & Scale**	**Patterns of Change**	**Form & Function**
Collect data Communicate understanding & ideas Design, conduct, & critique investigations Represent, analyze, & interpret data Experimental design Observe Predict Question and hypothesize Use evidence to draw conclusions Use tools, & techniques	Accumulation of science knowledge (evidence & reasoning, looking at work of others) Attitudes and dispositions of science (avoiding bias, divergent ideas, healthy skepticism) History of Science Science/Tech/ Society Scientific Theories	Cycles Energy Transfer Equilibrium Interactions Interdependence Order & Organization	Evidence provided through… Explanations provided through… Relative distance Relative sizes *Models include - experimental models, simulations, & representations used to demonstrate abstract ideas*	Constancy and Change Cycles Evolutionary Change	Natural World

5. The *Draft Rhode Island K-12 Grade Span Expectations in Science* are sequenced in the following manner:



6. Each Assessment Target contains a code before the narrative text of the target. These codes identify the specific Statement of Enduring Knowledge, the grade span, the connections to one or more Unifying Theme/Big Idea, and finally the target number.

   Table 3 illustrates an example: **LS1 (K-4) INQ+POC –1** means that this target addresses the first Life Science EK statement (**LS1**); the (**K-4**) grade span; is linked to Unifying Themes/Big ideas of Inquiry (**INQ**) and Patterns of Change (**POC**); and is the first assessment target listed (**1**) under the domain of Life Science. Some targets address only one Unifying Theme and others address more than one. For a more detailed explanation see ***READING A SCIENCE GSE*** found on page 6 of this document.

Table 3 Sample Target Coding

LS1 – All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, and species)

Elementary Target	Middle School Target	High School Target
LS1 (K-**4) INQ+POC –1** Sort/classify different living things using similar and different characteristics. Describe why organisms belong to each group or cite evidence about how they are alike or not alike.	LS1 (5-**8**) – INQ+ SAE- **1** Using data and observations about the biodiversity of an ecosystem make predictions or draw conclusions about how the diversity contributes to the stability of the ecosystem.	LS1 (9-**11**) INQ+SAE+FAF -**1** Use data and observation to make connections between, to explain, or to justify how specific cell organelles produce/regulate what the cell needs or what a unicellular or multi-cellular organism needs for survival (e.g., protein synthesis, DNA replication, nerve cells).

7. Assessment Target numbering is consecutive within each domain of science for each grade span. For example, at grades K-4, Life Science targets are numbered 1 though 9 (beginning with LS1, then continuing with LS2, LS3, and LS4); Physical Science targets begin the numbering again with 1 through 8 for PS1, PS2 and PS3; and Earth/Space Science targets again begin numbering 1 through 6.

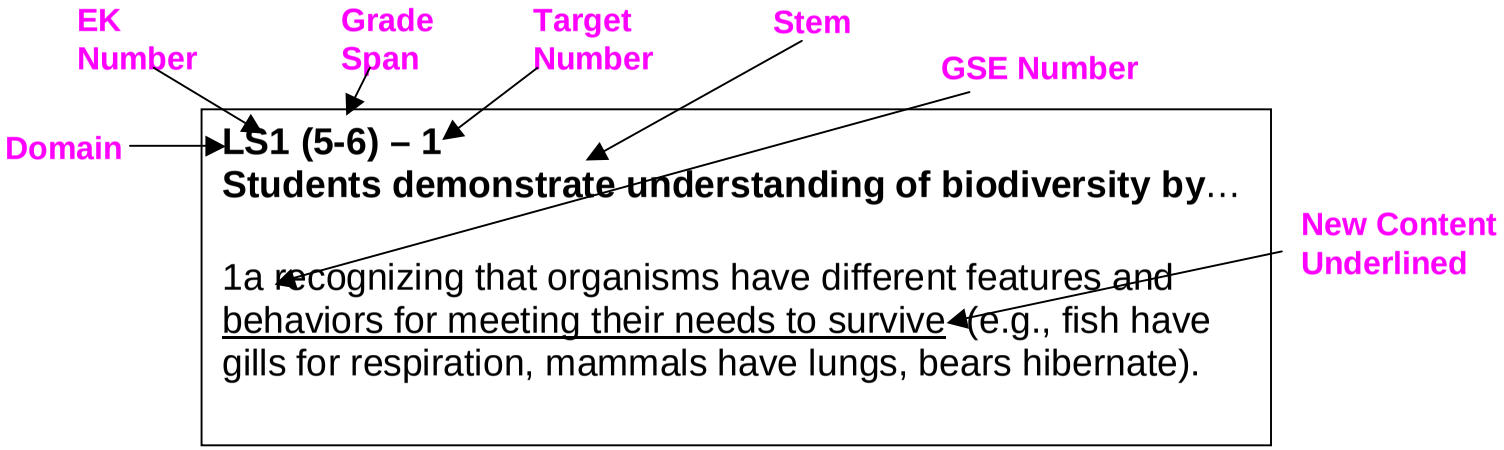
8. While the Statements of Enduring Knowledge are the same across all grade spans, the set of related targets within a grade span *do not address all aspects of the EK Statement.* This was done intentionally to focus instruction and assessment on the essential learning for the grade span, as well as on the developmentally appropriate concepts and skills. For example, at the elementary grade span, LS1 will focus on organisms and external structures, while the middle school grade span will move to internal structures and include organisms and population

The Tri-State Science Assessment Targets are…

- derived from and aligned with national and NH, RI, and VT's state science standards
- developed at the "intersections" by applying the Unifying Themes to the Statements of Enduring Knowledge [e.g., What "Systems & Energy" concepts are essential to understanding LS1: All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, and species)?]
- constructed with the understanding that not every Unifying Theme will have a meaningful "intersection" with every Statement of Enduring Knowledge
- designed to be general/broad enough to allow for multiple potential test items or assessment tasks with varying cognitive demands (Depth of Knowledge Levels)
- written, for the most part, with an intended cognitive demand ceiling consistent with Depth of Knowledge (DOK) Levels 2 (Skills & Concepts) or 3 (Strategic Thinking) – based on the work of Norman L. Webb

READING A SCIENCE GSE

Statement of Enduring Knowledge	Target
LS1 *All living organisms have identifiable structures and characteristics that allow for survival (organisms, populations, and species).*	**LS1 (5-8) – INQ + SAE- 1 Using data and observations about the biodiversity of an ecosystem make predictions or draw conclusions about how the diversity contributes to the stability of the ecosystem.**



PS1 - All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size or amount of substance).

PS1 (K-4) INQ –1 *Collect and organize data about physical properties in order to classify objects or draw conclusions about objects and their characteristic properties (e.g., temperature, color, size, shape, weight, texture, flexibility).*	***PS1 (5-8) INQ-1*** *Investigate the relationships among mass, volume and density.*	***PS1 (9-11) INQ –1*** *Use physical and chemical properties as determined through an investigation to identify a substance.*

Grade Span Expectations (K-4)		Grade Span Expectations (5-8)		Grade Span Expectations (HS)	
PS1 (K-2)–1 **Students demonstrate an understanding of characteristic properties of matter by …** **1a** identifying, comparing, and sorting objects by similar or different physical properties (e.g., size, shape, color, texture, smell, weight). **1b** recording observations/data about physical properties. **1c** using attributes of properties to state why objects are grouped together (e.g., things that roll, things that are rough).	**PS1 (3-4)–1** **Students demonstrate an understanding of characteristic properties of matter by …** **1a** identifying, comparing, and sorting objects by similar or different physical properties (e.g., size, shape, color, texture, smell, weight, temperature, flexibility). **1b** citing evidence (e.g., prior knowledge, data) to support conclusions about why objects are grouped/not grouped together. **Students demonstrate an understanding of physical changes by …** **1c** observing and describing physical changes (e.g. freezing, thawing, torn piece of paper).	**PS1 (5-6)-1** **Students demonstrate an understanding of characteristic properties of matter by …** **1a** comparing the masses of objects of equal volume made of different substances.	**PS1 (7-8) –1** **Students demonstrate an understanding of characteristic properties of matter by …** **1a** measuring mass and volume of both regular and irregular objects and using those values as well as the relationship D=m/v to calculate density.	**PS1 (9-11)–1** **Students demonstrate an understanding of characteristic properties of matter by …** **1a** utilizing appropriate data (related to chemical and physical properties), to distinguish one substance from another or identify an unknown substance. **1b** determining the degree of change in pressure of a given volume of gas when the temperature changes incrementally (doubles, triples, etc.).	**Example Extension(s)** **PS1 (Ext)–1** **Students demonstrate an understanding of characteristic properties of matter by …** **1aa** explaining the states of a substance in terms of the particulate nature of matter and the forces of interaction between particles. **1bb** quantitatively determining how volume, pressure, temperature and amount of gas affect each other (PV=nRT) in a system.

PS1 - All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size or amount of substance).

PS1 (K-4) POC –2 *Make a prediction about what might happen to the state of common materials when heated or cooled or categorize materials as solid, liquid, or gas.*		***PS1 (5-8) INQ+POC –2*** *Given data about characteristic properties of matter (e.g., melting and boiling points, density, solubility) identify, compare, or classify different substances.*		***PS1 (9-11) MAS+ NOS –2*** *Scientific thought about atoms has changed over time. Using information (narratives or models of atoms) provided, cite evidence that has changed our understanding of the atom and the development of atomic theory.*	
Grade Span Expectations (K-4)		**Grade Span Expectations (5-8)**		**Grade Span Expectations (HS)**	
PS1 (K-2) POC –2 **Students demonstrate an understanding of states of matter by …** **2a** describing properties of solids and liquids. **2b** identifying and comparing solids and liquids. **2c** making logical predictions about the changes in the state of matter when adding or taking away heat (e.g., ice melting, water freezing).	**PS1 (3-4) –2** **Students demonstrate an understanding of states of matter by …** **2a** describing properties of solids, liquids, and gases. **2b** identifying and comparing solids, liquids, and gases. **2c** making logical predictions about the changes in the state of matter when adding or taking away heat (e.g., ice melting, water boiling or freezing, condensation/evaporation).	**PS1 (5-6) –2** **Students demonstrate an understanding of characteristic properties of matter by …** **2a** recognizing that different substances have properties, which allow them to be identified regardless of the size of the sample. **2b** classifying and comparing substances using characteristic properties (e.g., solid, liquid, gas).	**PS1 (7-8) –2** **Students demonstrate an understanding of characteristic properties of matter by …** **2a** identifying an unknown substance given its characteristic properties. **2b** classifying and comparing substances using characteristic properties (e.g., solid, liquid, gas; metal, non-metal).	**PS1 (9-11)–2** **Students demonstrate an understanding of characteristic properties of matter by …** **2a** using given data (diagrams, charts, narratives, etc.) and advances in technology to explain how the understanding of atomic structure has changed over time.	**Example Extension(s)**
PS1 (K-4) SAE –3 *Use measures of weight (data) to demonstrate that the whole equals the sum of its parts.*		***PS1 (5-8) INQ+ SAE –3*** *Collect data or use data provided to infer or predict that the total amount of mass in a closed system stays the same, regardless of how substances interact (conservation of matter).*		***PS1 (9-11) POC –3*** *Explain how properties of elements and the location of elements on the periodic table are related.*	
Grade Span Expectations (K-4)		**Grade Span Expectations (5-8)**		**Grade Span Expectations (HS)**	
PS1 (K-2)–3 **Students demonstrate an understanding of conservation of matter by …** **3a** using simple tools (e.g. balance scale, see-saw) to explore the property of weight.	**PS1 (3-4)–3** **Students demonstrate an understanding of conservation of matter by …** **3a** measuring the weight of objects to prove that all matter has weight. **3b** using measures of weight to prove that the whole equals the sum of its parts. **3c** showing that the weight of an object remains the same despite a change in its shape.	**PS1 (5-6)–3** **Students demonstrate an understanding of conservation of matter by …** **3a** explaining that regardless of how parts of an object are arranged, the mass of the whole is always the same as the sum of the masses of its parts.	**PS1 (7-8) –3** **Students demonstrate an understanding of conservation of matter by …** **3a** citing evidence to conclude that the amount of matter before and after undergoing a physical or a chemical change in a closed system remains the same.	**PS1 (9-11)-3** **Students demonstrate an understanding of characteristic properties of matter by …** **3a** identifying and explaining the basis for the arrangement of the elements within the periodic table (e.g. trends, valence electrons, reactivity, electronegativity, ionization). **3b** predicting the relative physical and chemical properties of an element based on its location within the Periodic Table.	. **Example Extension(s)**

PS1 - All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size or amount of substance)				
No further targets for EK PS1 at the K-4 Grade Span	***PS1 (5-8) SAE+MAS – 4*** *Represent or explain the relationship between or among energy, molecular motion, temperature, and states of matter.*		***PS1 (9-11) MAS+ FAF – 4*** *Model and explain the structure of an atom or explain how an atom's electron configuration, particularly the outermost electron(s), determines how that atom can interact with other atoms.*	
Grade Span Expectations (K-4)	**Grade Span Expectations (5-8)**		**Grade Span Expectations (HS)**	
	PS1 (5-6) – 4 **Students demonstrate an understanding of states of matter by …** **4a** differentiating among the characteristics of solids, liquids, and gases. **4b** predicting the effects of heating and cooling on the physical state, volume and mass of a substance.	**PS1 (7-8) – 4** **Students demonstrate an understanding of states of matter by …** **4a** creating diagrams or models that represent the states of matter at the molecular level. **4b** explaining the effect of increased and decreased heat energy on the motion and arrangement of molecules. **4c** observing the physical processes of evaporation and condensation, or freezing and melting, and describe these changes in terms of molecular motion and conservation of mass.	**PS1 (9-11)– 4** **Students demonstrate an understanding of the structure of matter by …** **4a** comparing the three subatomic particles of atoms (protons, electrons, neutrons) and their location within an atom, their relative mass, and their charge. **4b** writing formulae for compounds and developing basic (excluding transition elements) models using electron structure. **4c** explaining or modeling how the electron configuration of atoms governs how atoms interact with one another (e.g. covalent, hydrogen and ionic bonding).	**Example Extension(s)** **PS1 (Ext)– 4** **Students demonstrate an understanding of the structure of matter by …** **4aa** writing an electron configuration to include *s*, *p*, *d*, and *f* orbitals and relating to atomic interactions. **4bb given** specific reactants (e.g. Ba + Cl_2) write the balanced equation and determine the products, type of compound formed (ionic or molecular), and the properties of the compound (e.g. solubilities, electrolytic, etc).

PS1 - All living and nonliving things are composed of matter having characteristic properties that distinguish one substance from another (independent of size or amount of substance)

No further targets for EK PS1 at the K-4 Grade Span	***PS1 (5-8) MAS –5*** *Given graphic or written information, classify matter as atom/molecule or element/compound (Not the structure of an atom).*		**No further targets for EK PS1 at the High School Grade Span**	
Grade Span Expectations (K-4)	**Grade Span Expectations (5-8)**		**Grade Span Expectations (HS)**	
	PS1 (5-6) – 5 **Students demonstrate an understanding of the structure of matter by …** **5a** distinguishing between solutions, mixtures, and "pure" substances, i.e. compounds and elements.	**PS1 (7-8) – 5** **Students demonstrate an understanding of the structure of matter by …** **5a** using models or diagrams to show the difference between atoms and molecules. **5b** classifying common elements and compounds using symbols and simple chemical formulas. **5c** interpreting the symbols and formulas of simple chemical equations. **5d** using symbols and chemical formulas to show simple chemical rearrangements that produce new substances (chemical change). **5e** explaining that when substances undergo physical changes, the appearance may change but the chemical makeup and chemical properties do not. **5f** explaining that when substances undergo chemical changes to form new substances, the properties of the new combinations may be very different from those of the old.		

PS 2 - Energy is necessary for change to occur in matter. Energy can be stored, transferred, and transformed, but cannot be destroyed.					
PS2 (K-4) SAE -4 *Given a specific example or illustration (e.g., simple closed circuit, rubbing hands together), predict the observable effects of energy (i.e., light bulb lights, a bell rings, hands warm up (e.g., a test item might ask, "what will happen when…?").*		***PS2 (5-8)-SAE+ POC- 6*** *Given a real-world example, show that within a system, energy transforms from one form to another (i.e., chemical, heat, electrical, gravitational, light, sound, mechanical).*		***PS2 (9-11) POC+SAE -5*** *Demonstrate how transformations of energy produce some energy in the form of heat and therefore the efficiency of the system is reduced (chemical, biological, and physical systems).*	
Grade Span Expectations (K-4)		**Grade Span Expectations (5-8)**		**Grade Span Expectations (HS)**	
PS2 (K-2)-4 **Students demonstrate an understanding of energy by…** **4a** describing observable effects of light using a variety of light sources**.** **4b** experimenting and describe how vibrating objects make sound (e.g., guitar strings, seeing salt bounce on a drum skin). **4c** identifying the sun as a source of heat energy.	**PS2 (3-4)-4** **Students demonstrate an understanding of energy by…** **4a** experimenting to identify and classify different pitches and volumes of sounds produced by different objects. **4b** using data to explain what causes sound to have different pitch or volume **4c** describing or showing that heat can be produced in many ways (e.g. electricity, friction, burning). **4d** drawing, diagramming, building, and explaining a complete electrical circuit. **4e** using experimental data to classify a variety of materials as conductors or insulators	**PS2 (5-6)- 6** **Students demonstrate an understanding of energy by…** **6a** differentiating among the properties of various forms of energy. **6b** explaining how energy may be stored in various ways (e.g. batteries, springs, height in terms of potential energy). **6c** describing sound as the transfer of energy through various materials (e.g. solids, liquids, gases).	**PS2 (7-8)- 6** **Students demonstrate an understanding of energy by…** **6a** using a real world example to explain the transfer of potential energy to kinetic energy. **6b** constructing a model to explain the transformation of energy from one form to another. (e.g. an electrical circuit changing electrical energy to light energy in a light bulb). **6c** explaining that while energy may be stored, transferred, or transformed, the total amount of energy is conserved. **'6d** describing the effect of changing voltage in an electrical circuit.	**PS2 (9-11)-5** **Students demonstrate an understanding of energy by…** **5a** describing or diagraming the changes in energy (transformation) that occur in different systems (eg. chemical = exo and endo thermic reactions, biological = food webs, physical = phase changes). **5b** explaining the Law of Conservation of Energy as it relates to the efficiency (loss of heat) of a system.	**Example Extension(s)** **PS2 (Ext)– 5** **Students demonstrate an understanding of energy by…** **5aa** Identifying, measuring, calculating and analyzing qualitative and quantitative relationships associated with energy transfer or energy transformation. **5bb** quantitatively determining the efficiency of a given system.

PS 2 - Energy is necessary for change to occur in matter. Energy can be stored, transferred, and transformed, but cannot be destroyed.					
PS2 (K-4) SAE – 5 *Use observations of light in relation to other objects/substances to describe the properties of light (can be reflected, refracted, or absorbed).*		***PS2 (5-8) INQ+SAE+POC – 7*** *Use data to draw conclusions about how heat can be transferred (convection, conduction, radiation).*		***PS2 (9-11) INQ+SAE -6*** *Using information provided about chemical changes, draw conclusions about and explain the energy flow in a given chemical reaction (e.g., exothermic reactions, endothermic reactions).*	
Grade Span Expectations (K-4)		**Grade Span Expectations (5-8)**		**Grade Span Expectations (HS)**	
PS2 (K-2)-5 **Students demonstrate an understanding of energy by…** **5a** demonstrating when a shadow will be created using sunny versus cloudy days.	**PS2 (3-4)-5** **Students demonstrate an understanding of energy by…** **5a** investigating observable effects of light using a variety of light sources (e.g., light travels in a straight line until it interacts with an object, blocked light rays produce shadows). **5b** predicting, describing, and investigating how light rays are reflected, refracted, or absorbed.	**PS2 (5-6) – 7** **Students demonstrate an understanding of heat energy by…** **7a** identifying real world applications where heat energy is transferred and showing the direction that the heat energy flows.	**PS2 (7-8) – 7** **Students demonstrate an understanding of heat energy by…** **7a** designing a diagram, model, or analogy to show or describe the motion of molecules for a material in a warmer and cooler state. **7b** explaining the difference among conduction, convection and radiation and creating a diagram to explain how heat energy travels in different directions and through different materials by each of these methods.	**PS2 (9-11) –6** **Students demonstrate an understanding of physical, chemical, and nuclear changes by …** **6a** writing simple balanced chemical equations to represent chemical reactions and illustrate the conservation of matter. **6b** identifying whether a given chemical reaction or a biological process will release or consume energy (endothermic and exothermic) based on the information provided (e.g. given a table of energy values for reactants and products or an energy diagram). **6c** explaining and/or modeling how the nuclear make-up of atoms governs alpha and beta emissions creating changes in the nucleus of an atom results in the formation of new elements. **6d** explaining the concept of half-life and using the half-life principal to predict the approximate age of a material. **6e** differentiating between fission and fusion in nuclear reactions and their relation to element changes and energy formation.	**Example Extension(s)** **PS2 (Ext)– 6** **Students demonstrate an understanding of physical, chemical, and nuclear changes by…** **6aa** using chemical equations and information about molar masses to predict quantitatively the masses of reactants and products in chemical reactions. **6bb** using quantitative heat flow or calorimetric investigations to determine the energy released or consumed in the process. **6bbb** qualitatively and/or quantitatively predicting reactants and products in a prescribed investigation. (e.g. Acid-base. Redox).

PS 2 - Energy is necessary for change to occur in matter. Energy can be stored, transferred, and transformed, but cannot be destroyed.					
PS2 (K-4) SAE+INQ – 6 *Experiment, observe, or predict how heat might move from one object to another.*				***PS2 (9-11) –SAE – 7*** *Explain relationships between and among electric charges, magnetic fields, electromagnetic forces, and atomic particles.*	
Grade Span Expectations (K-4)		**Grade Span Expectations (5-8)**		**Grade Span Expectations (HS)**	
PS2 (K-2)–6 **Students demonstrate an understanding of energy by…** **6a** describing that the sun warms land and water. **6b** describing that objects change in temperature By adding or subtracting heat.	**PS2 (3-4)–6** **Students demonstrate an understanding of energy by…** **6a** describing how heat moves from warm objects to cold objects until both objects are the same temperature. **6b** showing that heat moves from one object to another causing temperature change (e.g., when land heats up it warms the air).			**PS2 (9-11) –7** **Students demonstrate an understanding of electromagnetism by…** **7a** explaining through words, diagrams, models, or electrostatic demonstrations the principle that like charges repel and unlike charges attract. **7b** explaining through words, charts, diagrams, and models the effects of distance and the amount of charge on the strength of the electrical force present. **7c** describing the relationship between moving electric charges and magnetic fields.	**Example Extension(s)**

PS 3 - The motion of an object is affected by forces.

PS3 (K-4)-INQ+SAE –7 *Use data to predict how a change in force (greater/less) might affect the position, direction of motion, or speed of an object (e.g., ramps and balls).*		***PS3 (5-8) INQ+ POC –8*** *Use data to determine or predict the overall (net effect of multiple forces (e.g., friction, gravitational, magnetic) on the position, speed, and direction of motion of objects.*		***PS3 (9-11) POC+ INQ 8*** *Given information (e.g., graphs, data, diagrams), use the relationships between or among force, mass, velocity, momentum, and acceleration to predict and explain the motion of objects.*	
Grade Span Expectations (K-4)		**Grade Span Expectations (5-8)**		**Grade Span Expectations (HS)**	
PS3 (K-2) –7 **Students demonstrate an understanding of motion by…** **7a** showing how pushing/pulling moves or does not move an object. **7b** predicting the direction an object will or will not move if a force is applied to it. **Students demonstrate an understanding of force by…** **7c** showing that different objects fall to earth unless something is holding them up.	**PS3 (3-4)–7** **Students demonstrate an understanding of motion by…** **7a** predicting the direction and describing the motion of objects (of different weights, shapes, sizes, etc.) if a force is applied to it. **7b** describing change in position relative to other objects or background. **Students demonstrate an understanding of force (e.g., push-pull, gravitational) by…** **7c** investigating and describing that different amounts of force can change direction/speed of an object in motion. **7d** conducting experiments to demonstrate that different objects fall to earth unless something is holding them up.	**PS3 (5-6)–8** **Students demonstrate an understanding of motion by…** **8a** using data or graphs to compare the relative speed of objects. **Students demonstrate an understanding of force (e.g., friction, gravitational, magnetic) by…** **8b** recognizing that a force is a push or a pull. **8c** explaining that changes in speed or direction of motion are caused by forces. **8d** showing that electric currents and magnets can exert a force on each other.	**PS3 (7-8) – 8** **Students demonstrate an understanding of motion by…** **8a** measuring distance and time for a moving object and using those values as well as the relationship s=d/t to calculate speed and graphically represent the data. **8b** solving for any unknown in the expression s=d/t given values for the other two variables. **8c** differentiating among speed, velocity and acceleration. **Students demonstrate an understanding of force (e.g., friction, gravitational, magnetic) by…** **8d** making and testing predictions on how unbalanced forces acting on objects change speed or direction of motion, or both. **8e** describing or graphically representing that the acceleration of an object is proportional to the force on the object and inversely proportional to the object's mass. **8f** differentiating between mass and weight.	**PS3 (9-11)- 8** **Students demonstrate an understanding of forces and motion by…** **8a** predicting and/or graphing the path of an object in different reference planes and explain how and why (forces) it occurs. **8b** using modeling, illustrating, graphing explain how distance and velocity change over time for a free falling object.	**Example Extension(s)** **PS3 (Ext)- 8** **Students demonstrate an understanding of forces and motion by…** **8aa** using a quantitative representation of how distance and velocity change over time for a free falling object. **8bb** using a quantitative representation of the path of an object which has horizontal and free fall motion. **8cc.** by modeling, illustrating, graphing, and quantitatively explaining the path of an object, which has horizontal and free fall motion. e.g. football, projectile.

PS 3 - The motion of an object is affected by forces.				
PS3 (K-4) INQ+ SAE –8 *Use observations of magnets in relation to other objects to describe the properties of magnetism (i.e., attract or repel certain objects or has no effect)*		**No further targets for EK PS3 at the 5-8 Grade Span**	***PS3 (9-11) POC –9*** *Apply the concepts of inertia, motion, and momentum to predict and explain situations involving forces and motion, including stationary objects and collisions.*	
Grade Span Expectations (K-4)		**Grade Span Expectations (5-8)**	**Grade Span Expectations (HS)**	
PS3 (K-2)–8 **Students demonstrate an understanding of (**magnetic) **force by …** **8a** observing and sorting objects that are and are not attracted to magnets.	**PS3 (3-4)–8** **Students demonstrate an understanding of (**magnetic) **force by …** **8a** using prior knowledge and investigating to predict whether or not an object will be attracted to a magnet. **8b** describing what happens when like and opposite poles of a magnet are placed near each other. **8c** exploring relative strength of magnets (e.g., size of magnets, number of magnets, properties of materials).		**PS3 (9-11)–9** **Students demonstrate an understanding of forces and motion by…** **9a** explaining through words, charts, diagrams, and models the effects of distance and the amount of mass on the gravitational force between objects (e.g. Universal Gravitation Law). **9b** using Newton's Laws of Motion and the Law of Conservation of Momentum to predict the effect on the motion of objects.	**Example Extension(s)**

PS 3 - The motion of an object is affected by forces.				
No further targets for EK PS3 at the K-4 Grade Span	***PS3 (5-8) SAE+INQ – Local Assessment Only*** *Experiment, observe, or predict how energy might be transferred by means of waves.*		***PS3 (9-11) SAE –10*** *Explain the effects on wavelength and frequency as electromagnetic waves interact with matter (e.g., light diffraction, blue sky).*	
Grade Span Expectations (K-4)	**Grade Span Expectations (5-8)**		**Grade Span Expectations (HS)**	
	PS3 (5-6) - LA **Students demonstrate an understanding of waves by …** **LAa** investigate how vibrations in materials (e.g. pebble in a pond, jump rope, slinky) set up wavelike disturbances that spread away from the source.	**PS3 (7-8) - LA** **Students.demonstrate an understanding of the visible spectrum of light by…** **LAa** experiment how light from the sun is made up of a mixture of many different colors of light (e.g. using prisms, spectrometers, crystals). **LAb** representing in words, diagrams, or other models the visible spectrum as a part of the electromagnetic spectrum (consisting of visible light, infrared, and ultraviolet radiation) and composed of all colors of light **LAc** differentiating between electromagnetic and mechanical waves.	**PS3 (9-11)–10** **Students demonstrate an understanding of waves by …** **10a**. investigating examples of wave phenomena (e.g. ripples in water, sound waves, seismic waves). **10b** comparing and contrasting electromagnetic waves to mechanical waves. **10c** qualifying the relationship between frequency and wavelength of any wave.	**Example Extension(s)**
Total K-4 Targets for PS = 8 **Total K-4 GSEs for PS = 40 (K-2 = 15, Grades 3-4 = 24)**	**Total 5-8 Targets for PS = 8 (+ 1 Local Assessment)** **Total 5-8 GSEs for PS = 45 (Grades 5-6 = 16, Grades 7-8 = 28)**		**Total H.S. GSE Targets for PS = 10** **Total H.S. GSEs for PS = 25** **Total Extension GSEs for PS = 11**	